[0013] According to one aspect of the present invention, a process of electrodepositing at least one ferromagnetic material into a three dimensional pattern within a substrate is provided. The substrate may be comprised of electrically conductive materials, dielectric materials, or a combination thereof. A substrate material is provided having an electrically conductive three dimensional recessed pattern in at least one outer surface thereof. When using a dielectric substrate, a thin electrical conductive material is first deposited within the three dimensional pattern and optionally the outer surface of the substrate having the three dimensional pattern, providing a seed layer on the substrate. Providing an electrically conductive outer surface and an electrically conductive three dimension pattern may provide a more efficient deposition process. An electrolytic bath comprising at least one ferromagnetic material and at least one inhibiting, accelerating or depolarizing additive is prepared. The at least one ferromagnetic material comprises at least one metal cation selected from the group consisting of Ni , Co^{2+}, Fe^{2+}, Fe^{3+}, and combinations thereof, and the anion typically being sulfate, chloride, sulfamate or some combination thereof. The substrate with seed layer is placed into the electrolytic bath wherein the at least one outer surface and three dimensional pattern is contacted by the electrolytic bath. A counter electrode is placed into the electrolytic bath whereby an electrical current is passed through the electrolytic bath between the seed layer on the substrate and the counter electrode. At least a portion of the at least one ferromagnetic material is deposited into at least a portion of the three dimensional pattern wherein the deposition of the at least one ferromagnetic material is substantially void-free.

[0014] According to another aspect of the present invention, the at least one accelerating, inhibiting, or depolarizing additive comprises a nitrogen containing compound.

[0015] According to yet another aspect, the at least one accelerating, inhibiting, or depolarizing additive has at least one compound selected from the group consisting of cationic surfactants, anionic surfactants, nonionic surfactants, heterocyclic benzimidazole derivatives, and combinations thereof.

[0016] According to a further aspect of the present invention, the at least one accelerating, inhibiting, or depolarizing additive comprises at least one compound selected from the group consisting of polyethyleneimine (PEI), 2-mercapto-5-benzimidazolesulfonic acid (MBIS), and combinations thereof.

[0017] According to yet a further aspect of the present invention, the at least one accelerating, inhibiting, or depolarizing additive comprises PEI.

[0018] According to another aspect of the present invention, the at least one accelerating, inhibiting, or depolarizing additive comprises MBIS.

[0019] According to yet another aspect of the present invention, a process of electrodepositing at least one ferromagnetic metal into a three dimensional pattern within a substrate is provided. The process comprising: providing a substrate material comprising an electrical conductive three dimensional recessed pattern in at least one surface thereof; preparing an electrolytic bath comprising at least one ferromagnetic metal cation selected from the group consisting of N2+, Co2+, Fe2+, Fe3+, and combinations thereof; mixing at least one accelerating, inhibiting, or depolarizing additive into the electrolytic bath; placing the electrical conductive pattern of the substrate into the electrolytic bath; contacting the electrical conductive pattern of the substrate with the electrolytic bath; placing a counter electrode into the electrolytic bath; passing an electrical current through the electrolytic bath between the electrical conductive pattern of the substrate and the counter electrode; the electrical current being passed between the electrical conductive pattern of the substrate and the counter electrode is such that the potential between the substrate and a reference electrode is at a value negative of -0.8V SCE or at an applied current density in the range of 0.1 to 50 mA/cm2 of the area of the electrically conductive pattern of the substrate, or both; and depositing at least a portion of the at least one ferromagnetic material into at least a portion of the three dimensional pattern wherein the at least one deposited ferromagnetic material is substantially void-free.

[0020] According to a further aspect of the present invention, a process of electrodepositing at least one ferromagnetic material into a three dimensional pattern within a substrate is provided. The process comprising: providing a substrate material having an electrical conductive portion with a three dimensional recessed pattern; preparing an electrolytic bath comprising the at least one ferromagnetic material and at least one accelerating, inhibiting, or depolarizing additive; the at least one ferromagnetic material comprising at least one metal cation selected from the group consisting of N2+, Co2+, Fe2+, Fe3+, and combinations thereof; placing the electrical conductive portion of the substrate into the electrolytic bath; contacting the electrical conductive portion of the substrate with the electrolytic bath; placing a counter electrode into the electrolytic bath ; passing an electrical current through the electrolytic bath between the electrical conductive portion of the substrate and the counter electrode; and depositing at least a portion of the at least one ferromagnetic material into at least a portion of the three dimensional pattern wherein the at least one deposited ferromagnetic material is substantially void-free.

[0021] According to yet a further aspect of the present invention a process of electrodepositing at least one ferromagnetic material into a three dimensional pattern within a substrate is provided. The process comprising: providing a substrate material having an electrical conductive three dimensional recessed pattern in a surface thereof; preparing an electrolytic bath comprising the at least one ferromagnetic material and at least one accelerating, inhibiting, or depolarizing additive; the at least one ferromagnetic material comprising at least one metal cation selected from the group consisting of N2+, Co2+, Fe2+, Fe3+, and combinations thereof; the at least one accelerating, inhibiting, or depolarizing additive comprising an additive selected from the group consisting of polyethyleneimine, 2-mercapto-5-benzimidazolesulfonic acid, and combinations thereof; placing the electrical conductive three dimensional recessed pattern in the substrate into the electrolytic bath; contacting the electrical conductive three dimensional recessed pattern in the substrate with the electrolytic bath; placing a counter electrode into the electrolytic bath; passing an electrical current through the electrolytic bath between the electrical conductive three dimensional recessed pattern in the substrate and the counter electrode; and depositing at least a portion of the at least one ferromagnetic material into at least a portion of the three dimensional recessed pattern in the substrate wherein the at least one deposited ferromagnetic material is substantially void-free.

[0022] According to another aspect of the present invention, the process step of preferentially depositing the ferro-